

TECHNICAL REPORT  
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# ACCEPTABILITY OF CARRYING DEVICES OF STANDARD AND EXPERIMENTAL DUFFEL BAGS

by

John M. McGinnis, Ph.D.

September 1968

UNITED STATES ARMY  
NATICK LABORATORIES  
Natick, Massachusetts 01760



Pioneering Research Laboratory  
EPT-8

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STANDARD AND EXPERIMENTAL DUFFEL BAGS

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Behavioral Sciences Division

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## FOREWORD

Duffel bags developed many years ago were carried by one or two rope drawstrings which were threaded through grommets equally spaced around the top of the bag. After the drawstrings were pulled tight, the closed bag was slung over the shoulder by the extra rope.

Later the Army standardized a bag which was closed by placing four grommets over an elongated metal loop and holding them in place by a snap-hook. The hook was attached to one flat shoulder strap which was securely attached to the side of the bag at two places to form a grip for carrying by one hand.

The purpose of the present study was to determine the relative ease of carrying a newly designed duffel bag having two straps as compared with the standard one-strap bag and to secure an experimental basis for developing an improved item which will be easier to handle and more acceptable to Army personnel.

## CONTENTS

	<u>Page</u>
Abstract	iv
Introduction	1
Method	1
Results	5
Conclusions	9
Acknowledgments	11
Appendix	
Descriptions, drawings and carrying positions of duffel bags.	12

## ABSTRACT

The standard one-strap Army duffel bag, three experimental two-strap bags, and later two improved experimental two-strap bags were used by volunteer test subjects to carry loads over indoor and/or outdoor courses. The test subjects were observed and their handling of the bags recorded as they traversed the courses. The standard army bag with one shoulder strap was carried over the course by the average subject in four of five different positions as compared with the two-strap bags which were seldom carried in more than one position. Interviews were held on each day immediately after the final traversal of the course by each group to record individual preferences and comments concerning the bags. All three experimental (two-strap) bags were definitely preferred over the standard one strap design, and two experimental designs proved to be equally acceptable and definitely superior to the third experimental design. Later the two improved two-strap bags based on the best two of the three original experimental designs were compared and found to be equally acceptable. Although no direct experimental comparisons were made, comments indicated that the improved bags were considered to be superior to and more acceptable than the experimental bags which were tested first.

## ACCEPTABILITY OF CARRYING DEVICES STANDARD AND EXPERIMENTAL DUFFEL BAGS

### Introduction

A requirement exists to improve the current carrying devices on the Army duffel bag. The purpose of the proposed modification is to facilitate ease of carrying the bag on a soldier's back, leaving his hands free and avoiding having to carry the bag on a single shoulder. The objectives of the study were to compare the acceptability of three experimental duffel bags with each other and with the standard bag, and to secure information about the acceptability of the carrying devices of each bag as a basis for improving its design and developing a new bag which will be easier to carry.

### Method

#### Duffel bags

A standard duffel bag and Type I, Type II, and Type III experimental bags were fabricated by the Clothing and Equipment Development Division of the Clothing and Organics Materials Laboratory, U. S. Army Natick Laboratories (see Appendix). They were made available, fully loaded (57-3/4-lbs.), to the Behavioral Sciences Division of the Pioneering Research Laboratory at Natick. The duffel bags were used exactly as received over the indoor walking course described below.

#### Test subjects

Twenty-four volunteer test subjects at Natick's Climatic Research Laboratory, all enlisted men in good physical condition, participated in the experiment. They were used in different groups and in a different order on the two walking courses.

#### Walking courses and Procedures

An "Indoor Walking Course" approximately 2,000 feet in length was established to roughly simulate an airport



terminal situation.\* It was mainly although not entirely indoors. Test subjects walked the course in a pre-determined random order at a steady pace in approximately 8 minutes. An "Outdoor Walking Course" approximately the same length (2,000 feet) as the "Indoor Course" traversed walks and roads and did not include doors and steps which were included in the indoor course.\*\* It was completed in approximately 6½ minutes. The only steps involved in the outdoor course were those up and down curbs. However, there were some gradual down hill slopes in the first half and a moderately steep up-grade near the end of the course. On both courses subjects were instructed to carry the bags in a standard manner (i.e. the standard bag was carried by its strap over one shoulder and the experimental bags were carried with the straps over the shoulders)(see Appendix) during the first quarter of the course, after which they were free to carry the bags in any way that they pleased. On the indoor course, test subjects were told to remain 5 to 10 paces apart so that each test subject had to open all the doors. This distance was reduced to 5 paces on the outdoor course. Instructions, rules, pace-setting, and 12 minute rest periods between trials were essentially the same for both courses. For both courses a monitor recorded major changes in bag position and the point on the course where they occurred. He also noted any other irregularities in performance such as stopping, staggering, stumbling, extreme postures, and spontaneous remarks which were relevant to the bags.

\*The indoor course started in the Climatic Building, went out the front door, down steps, across the street and up steps into the Research Building. Inside the building it went up a flight of stairs to the second floor, through a door and down a corridor the length of the second floor, through a door, down another flight of stairs, out the door and along the sidewalk to the west end of the Development Building. Then it went into the Development Building, along the corridor to the east end and down the front steps to the sidewalk. From there it went south along the sidewalk past the front of the Research Building, across the street, and up the steps into the Climatic Building.

\*\*The outdoor walking course started in front of the east door of the Research Building, went out to the sidewalk, along it to the circle, diagonally across the circle, then east along the sidewalk on the south side of "C" Street, to the first intersection, south along the sidewalk and street between the Climatic and Army Research Institute for Environmental Medicine buildings almost to the Officers Club, east to the road along the lake, north on it past the Army Research Institute for Environmental Medicine building to the intersection with "C" Street, west on the sidewalk up the hill to the Circle, and diagonally across the street at the circle to the front of the Research Building.

### Clothing and personal equipment

Fatigues and leather combat boots were worn on the indoor course. On the outdoor course standard helmets and helmet liners also were worn, along with webbing equipment. This latter included 3-1/4 pounds of simulated weight in each of two ammunition pouches, the simulated weight and bulk of sun glasses, a new folding intrinsching tool in its carrier, and a canteen (without cup) filled with water, for a total of 18-3/4 pounds. Also, each test subject carried an M-1 carbine. Total weight carried on this course was 80 pounds, clothing not included.

### Experimental design

Three separate Latin square designs were used to compare the duffel bags. Each test subject traversed the indoor course once while carrying each of four duffel bags, the standard, Type I, Type II and Type III. Twelve minute rest periods were allowed, following each traversal. Also, during the following week, each test subject traversed the outdoor course once with the standard, Type I and Type III bags. On Thursday of the third week, each of 16 test subjects traversed the indoor course twice while carrying the Type IV and Type V bags, which were designed and constructed following experience with the standard, Type I, Type II, and Type III bags on the two courses. In each design a compensating order was used to minimize order effects.

### Interviews

Interviews were held after the final traversal of the course by each group. Test subjects were not permitted to discuss the bags until after the interview, and they were interviewed in the order in which they traversed the course. An interview outline was followed closely, so that the same questions were asked all test subjects regarding the bags carried. Overall preference for the bags were recorded first and questions were then asked concerning each bag, in order, beginning with the most preferred and ending with the least preferred bag. Answers and spontaneous comments were recorded as nearly verbatim as possible.

Favorable and unfavorable comments were tabulated separately for each of the bags and in reply to the question "Is there anything else which you would like to say about any of the bags?".\*

\*Duffel Bag Test - Interview Outline

(After test, interview one man at a time. Do not give men an opportunity to confer.)

"YOU HAVE NOW CARRIED (4, 3 or 2) BAGS OVER THE COURSE."

"YOU CARRIED THEM IN THE ORDER:" (Indicate order in which bags were carried.)

"HERE ARE THE BAGS: "(Arranged in order: Standard, Type III, Type I, Type II).

1 2 3 4

"POINT TO THE ONE YOU LIKED BEST TO USE! (Record answers here)  
NEXT BEST! NEXT! LEAST!

#1.a. "WHY DID YOU LIKE THIS ONE" (POINT) BETTER THAN THE OTHERS?"

b. "WHAT ELSE DID YOU LIKE ABOUT THIS ONE?"

c. "WAS THERE ANYTHING YOU DID NOT LIKE ABOUT THIS ONE?"

#2.a. "WHAT DID YOU LIKE ABOUT THIS ONE?"

b. "WHAT DID YOU NOT LIKE ABOUT THIS ONE?"

#3 (Same as #2)

#4 (Same as #2)

IS THERE ANYTHING ELSE WHICH YOU WOULD LIKE TO SAY ABOUT ANY OF THE BAGS?"

## Results

### Preferences

Preferences for use of the bags were tabulated. On the indoor course the standard bag was least preferred, being ranked last by all 24 test subjects. The Type I bag was liked best by 13 subjects, the Type III bag was liked best by 10 subjects, and one subject ranked the Type II bag first. The difference in preference for the Type I and Type III bags was not statistically significant on the Sign test. However, both the Type I and Type III bags were significantly preferred over the Type II bag ( $p < .05$ ) and the Type I, Type III and Type II bags were all significantly preferred to the standard bag ( $p < .01$ ) on the same test.

On the outdoor course,\* thirteen of the 24 test subjects preferred to use the Type I bag, 10 preferred the Type III bag, none preferred the standard bag, and one expressed no preference among the three.\*\* Twenty-two of the 24 test subjects rated the standard bag as the one they liked least, one expressed no preference between the bags, and one rated the standard bag over the Type I bag because it was easier to shift the weight of the standard bag. In summary, both the Type I and Type III bags were significantly preferred over the standard bag ( $p < .05$  on the Sign test). The small 13 to 10 preference for Type III over Type I was not statistically significant.

### Carrying positions

There were no statistically significant differences between the Type I, Type II, and Type III bags (all two strap bags) for the total number of positions in which each bag was carried over either the indoor or outdoor courses.

\*The standard, Type I and Type III duffel bags were completely repacked after the indoor course was completed and before they were carried over the outdoor course. More clothing and other soft materials were used and all hard objects which might dig into the test subjects either were removed or heavily wrapped in soft materials. The repacked bags were somewhat fuller and a little lighter than before (55 3/4-pounds for each of the three bags).

\*\*The Type II bag was not used over the outdoor course for two reasons. It was significantly lower in acceptability over the indoor course than were Types I and III, and human factors analysis and test subject comments emphasized the discomfort caused by the "D" rings at the lower end of the straps. The rings dug into the lower part of the back. This was particularly true of the center ring, which did not seem to have any use. Since the desirable characteristics of Type II also were characteristic of Type I, they were not lost from the study.

Typically, each subject slung each two-strap bag over his shoulders by the straps and allowed it to remain in that position, except for minor shifting of the positions of the shoulder straps, until the course was completed. The only exceptions were that one subject carried the Type III bag in two positions on the indoor course and another carried both the Type I and Type III bags in two positions on the outdoor course. In contrast, the standard bag was carried in from one to 10 different positions by individual test subjects with a mean of 5.3 positions on the indoor course and 4.6 on the outdoor test course. The standard bag differed significantly from all three of the two-strap experimental bags in this respect, 23 to 0 ( $p < .01$  on the Sign test). Only one subject carried the standard bag over the entire course in the original position with the strap slung over one shoulder.

#### Comments concerning experimental bags carried over the indoor course

##### Standard

Almost nothing was liked about the standard bag, except that "you can get most of your things in it" and "the hand grip on the side of the bag is sometimes handy". Most of the unfavorable comments related to awkwardness, discomfort, and the difficulty of handling and carrying in any position. The least disliked methods of carrying were balancing the bag on top of a shoulder, or across a shoulder and the back of the neck.

##### Type I

Favorable comments on the Type I bag, which ranked first in acceptability, were that the straps were farther apart, more comfortable, balanced better, and the bag was easier than the others to put on and to carry. Common unfavorable comments were that the straps cut into the shoulders, hurt a little under the arms, and pulled too heavily on the outside of the shoulders.

##### Type II

Favorable comments on the Type II bag were similar to those of the Type I bag, but were fewer in number. Unfavorable comments on the Type II bag dealt mainly with the "D" rings being heavy, noisy and digging into the lower part of the back. The center "D" ring was particularly annoying. As with the Type I bag, criticisms were made of lack of padding on the straps. Also the straps on the Type II bag were considered difficult to adjust.

### Type III

The padding on the shoulder straps of the Type III bag was generally liked and almost half of the test subjects thought it was the easiest bag to carry. However, there were some complaints that the straps were too close at the shoulders and pressed on the sides and back of the neck. Other complaints were that the balance was awkward, and that the placement of the straps was not liked.

There were also some criticisms of lumpy and hard items in the bags which dug in when the bags were carried over the indoor course in some positions. These criticisms were made of all four bags, but applied particularly to the standard bag, which was carried in more different positions than the others.

### Comments concerning bags carried over the outdoor course

These bags were carried along with webbing equipment and the M-1 carbine, a total weight of 80 lbs.

### Standard

1 For the standard bag, comments in response to "What did you like about this bag?" were typically to the effect that they did not like anything about it. More specific comments were that it was awkward, hard to handle, very hard to carry off balance, "The worse thing in the world to carry"; "There is no way to put the bag so it is comfortable"; "There is no comfortable way of carrying it"; "One strap really cut in the shoulder"; and "There seemed to be no comfortable way to arrange strap for carrying".

### Type I

Most of these were more favorable, such as "Went on easier, was comfortable, felt balanced on my back, rode easier on my shoulders, weight was distributed better, and straps had less pull around the shoulders." Unfavorable comments included "Straps rumple up and out into your shoulders"; "Straps are too far apart"; "Straps didn't fit onto your shoulder good"; "Pulls too heavily on the outside of the shoulders where the muscles are weaker"; "Was harder to put on and take off"; "It kept slipping to one side"; and "Likes straps attached to the side instead of the middle of the back".

### Type III

These also were more favorable than comments about the standard bag: "Liked padding on the straps, kept more on the center when worn with the combat pack, carries a lot easier, comfortable on my shoulders"; "Think the weight is better distributed and the straps are padded"; "I liked the padding and it was easy to carry". For Type III, unfavorable comments were: "Hard to adjust, more difficult than Type I to carry, do not like straps close together (at top)"; "Puts pressure on back of my neck"; "Straps are too tight around the shoulder"; "It is the best of the three, and still feel some pressure on the back and sides of the neck".

### Comments concerning the suitability of the walking courses

As a check on the suitability of the courses, the last six subjects who traversed the indoor course, and the 24 subjects who carried the bags over the outdoor course were asked two questions. In answer to the question "Was the course long enough for you to tell the difference between the bags?" 28 answered "yes", one answered "no", and one failed to answer. In reply to the question "Was the course longer than it needed to be?" only two thought the course was too long, one thought it was too long for the standard bag only, one thought it was not long enough, 24 thought that it was not too long, and two did not answer. It appears justified to conclude that the courses were of reasonable length and difficulty for the purpose for which they were used.

### Evaluation of Improved Type IV and Type V bags

#### Construction of Type IV and Type V bags

All the comments made following traversal of the indoor and outdoor courses were read by the experimenter and by representatives of the Clothing and Equipment Development Division (C&EDD) for suggestions for improving duffel bag design or construction. An improved Type IV duffel bag based on the Type III prototype and an improved Type V bag based on the Type I prototype were constructed by C&EDD and carried over the indoor course. Both bags included padded shoulder straps and adjustable aluminum buckles as used in the standard lightweight webbing. The design and construction of both bags were improved in accordance with comments made by the test subjects and as a result of the knowledge, experience and skill gained by C&EDD personnel while designing and constructing load-carrying equipment.

Sixteen test subjects who had already carried the standard, Type I, Type II and Type III bag now carried Type IV and Type V bags over the indoor course, following the same procedure except for modifications required by the use of only two bags.

#### Preferences

Eight test subjects preferred the Type IV bag and 8 preferred Type V.

#### Comments

The most common reason for preferring either bag was the comfort with which it could be carried. The group was evenly divided regarding which bag was more comfortable. Most subjects considered both bags to be good ones, and differences between them were described as small. The padding on the straps and the ease of adjusting the straps were the best liked features.

#### Comparisons between Type IV and Type V bag and the other duffel bag

Because of non-availability of additional test subjects and an immediate need to use the results of the study, no direct experimental comparisons were made between the Type IV and V bags and the standard and Type I, II and III bags. However, the 16 test subjects were asked to express a preference between Type IV and V bags and those they had carried earlier. Of the 14 who expressed a definite opinion, 11 preferred the Type IV and V bags, three did not think there was much difference between the two sets of bags, and none preferred the Standard or Type I, II or III bag. In general, the group judged the Type IV and V bag to be far superior to the standard bag and definitely improved in comfort and convenience as compared with the Type I, II and III bag.

#### Conclusions

When carried over the indoor course, the Type I, II, and III duffel bag (all two-strap bag) were significantly preferred by the test subjects over the standard bag, and Type I and Type III were significantly preferred over Type II. There was no significant difference in preference between Types I and III.



The Type I and Type II bags were carried over the entire indoor course in the same position without a major shift by all 24 test subjects, and only one test subject shifted the position of the Type III bag. In contrast, the standard bag was carried in over 5 different positions by the average test subject, and only one test subject carried this bag in the same position over the entire course.

The padding on the straps of the Type III bag was generally liked.

The test subjects' comments regarding the advantages and disadvantages of the strap arrangements on the Type I and Type III bags differed greatly and were sometimes contradictory.

When carried over the outdoor course with field equipment the Type III and Type I bags were significantly preferred over the standard bag, but did not differ significantly from each other in acceptability.

The standard bag was carried over the outdoor course in many more positions (mean is 4.63 per test subject) than the Type I bag (mean 1.04), or the Type III bag (mean 1.04).

The Type IV and Type V bags were preferred by equal numbers of test subjects.

The test subjects' comments regarding the advantages and disadvantages of the strap arrangements on the Type IV and Type V bags differed greatly and were sometimes contradictory.

Although no direct experimental comparisons were made, comments indicated that in general the Type IV and Type V bags were definitely more acceptable than the other bags used in the test. Best liked features were the padded straps and the easily adjustable buckles on the carrying straps.

### Acknowledgments

A number of Personnel, both military and civilian, were involved in this study, and their participation is greatly appreciated. Efficient cooperation was received from the 24 Test Subjects and also from Mr. Fred Wardrop and Sergeant Gibson Nash of the Climatic Research Laboratory Coordination Office; Mr. John Slauta, Mr. Charles Sorrento, Mr. Eldon Metzger, and Mr. John Driscoll of the Clothing and Equipment Development Division; and Mr. Brian Crist, Mrs. Rosamond Kopelman, Captain Harold Kiess, Lt. Stephen Lacy, SP-4 Alfred Boileau and SP-4 Earl Summers of the Behavioral Sciences Division of the Pioneering Research Laboratory. Specialist Summers also prepared the duffel bag drawings. Specialist Boileau made an important contribution by observing the test subjects as they traversed the walking courses and by recording their behavior in relation to the bags carried.

## APPENDIX

Descriptions, drawings and carrying positions of duffel bags.

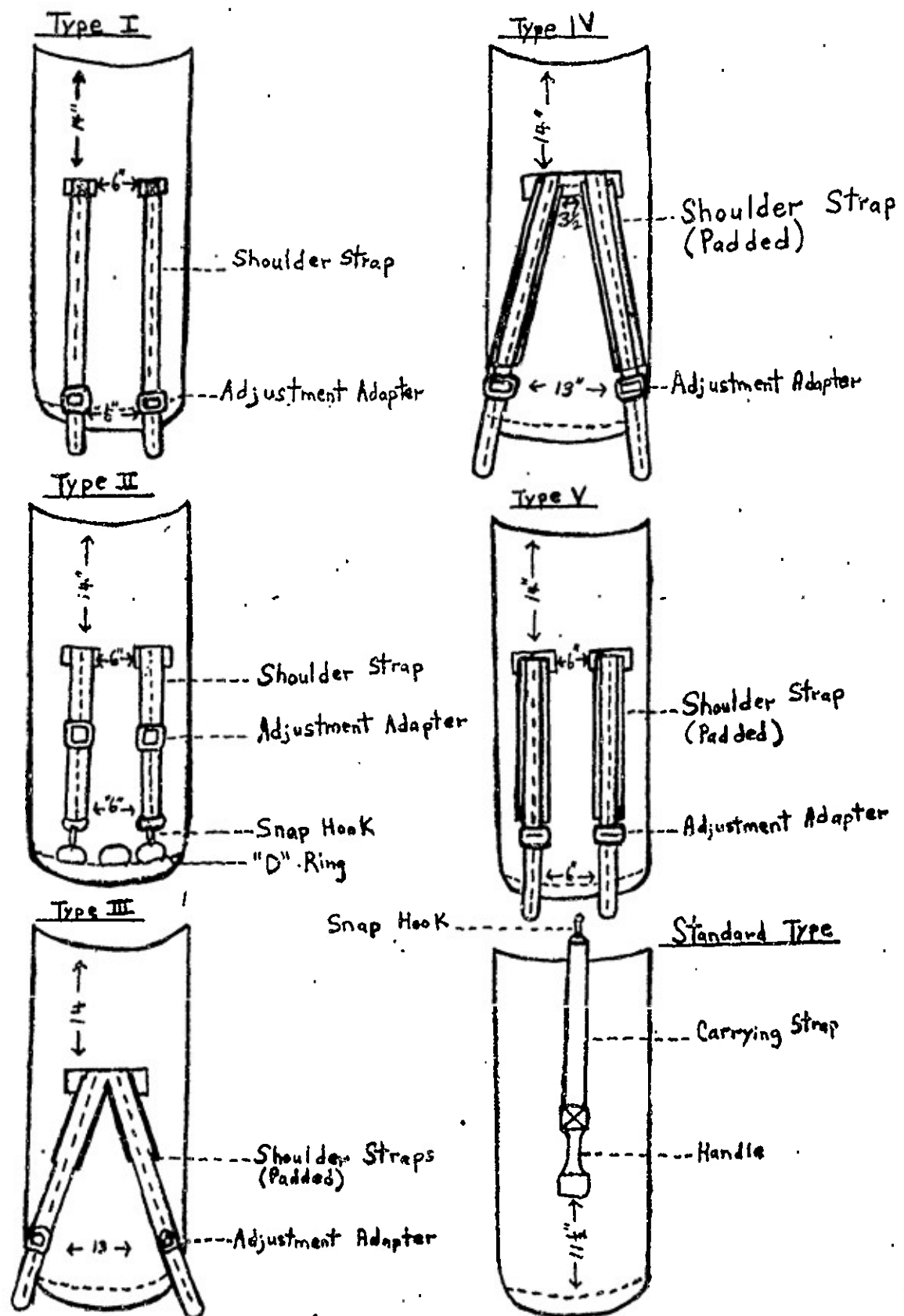
The experimental bags were made in accordance with rough prototypes constructed at Fort Lee and described in an "Evaluation Resume of Modified Duffel Bags", by SGT James H. Stripe, U.S. Army General Equipment Test Activity, Fort Lee, Virginia.\* Each one was identical in size, shape and material to the current standard bag, but differ as follows:

Type I - Shoulder straps were provided. They were sewn at the top approximately 14 inches from the top of the bag, and the straps were approximately 6 inches apart. The straps were made of 1-3/4 inch wide cotton duck material and were 32 inches long. Two buckles, located on the bottom of the bag, were separated approximately 6 inches apart. The straps were threaded through the buckle and adjusted for fit.

Type II - Identical in design to the Type I bag, except that it was provided with three "D" rings at the bottom of the bag and each shoulder strap had an adjustment buckle and a snap hook. Each strap could be attached to either the "D" rings located on the side or to the "D" ring located in the center.

Type III - Identical in design to Type I bag, except the shoulder straps were located together at the top and separated about 15 inches at the bottom.

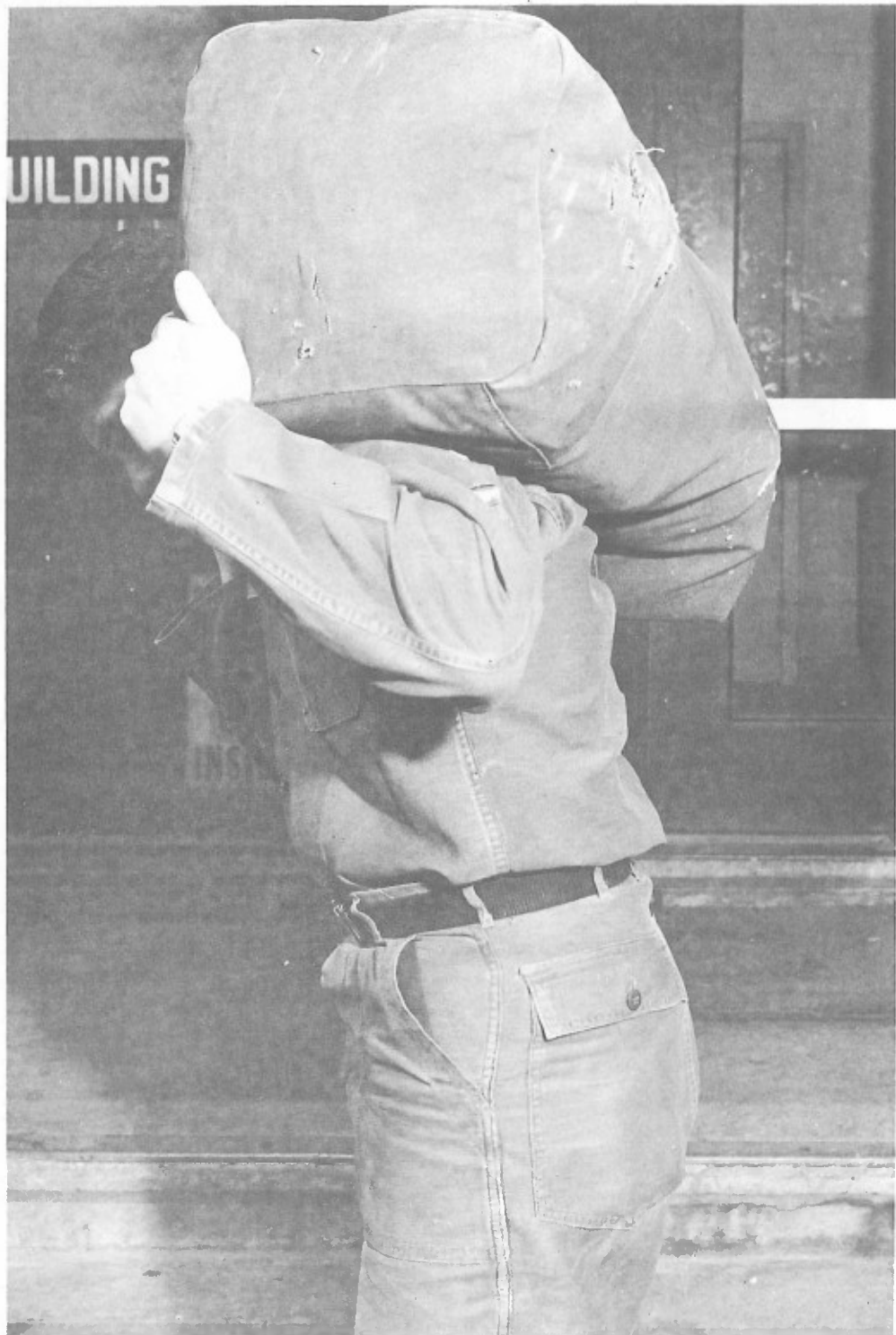
\*undated report.



Duffel Bags - Standard and Types I, II, III, IV, and V.



Standard Duffel Bag, Slung Over Shoulder by Strap



Standard Duffel Bag, Balanced on Shoulder and Back of Neck  
15



Type I Experimental Duffel Bag with Field Gear, Side View  
16

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<p>The standard one strap army duffel bag, three experimental two-strap bags, and later two improved experimental two-strap bags were used by volunteer test subjects to carry loads over indoor and/or outdoor courses. The test subjects were observed and their handling of the bags recorded as they traversed the courses. The standard army bag with one shoulder strap was carried over the course by the average subject in four of five different positions as compared with the two-strap bags which were seldom carried in more than one position. Interviews were held on each day immediately after the final traversal of the course by each group to record individual preferences and comments concerning the bags. All three experimental (two-strap) bags were definitely preferred over the standard one strap design, and two experimental designs proved to be equally acceptable and definitely superior to the third experimental design. Later the two improved two-strap bags based on the best two of the three original experimental designs were compared and found to be equally acceptable. Although no direct experimental comparisons were made, comments indicated that the improved bags were considered to be superior to and more acceptable than the experimental bags which were tested first.</p>			

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Tests	8					
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